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Waste Heat Recovery from Furnace Exhaust Gas

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Abstract: *Energy Conservation is unquestionably of great importance, since the current energy resources are diminishing fast and the renewable resources' ability to provide to the extreme energy needs of the society in a dependable way is limited. Metal casting is one of the most energy-intensive industries in the world.*

In metal casting process of melting the molten metal in the circuble, large amount of heat energy in wasted into atmosphere.

If this heat energy can be absorbed by the raw materials by a suitable arrangement, it will reduce energy consumption during melting, resulting in savings in economy and environment.

In This paper discusses an innovative approach to implement such a methodology. In a basic set up, when this preheating was achieved, the scrap was found to take 2.83 % less energy than it would take to melt without this preheating set up.

This technique has been improvised by keeping aluminum powder in between the scrap and the hot casting to have better heat recovery,
resulting in an increase of heat recovery to the tune of 5.7 %. When this savings are applied to global castings produced.

1. Introduction

In the present world where there is an exponential increase in the energy crisis, it becomes an immediate necessityfor the people to conserve energy. Manufacturing using foundries is a well established process in practice throughout the world.
More than 50% of the energy consumed by the foundries is spent in melting the raw materials and this energy goes waste when the ehaust gas released in furnance.
Heat released on the furnance is used to preheat the raw materials. The experiment was done using aluminium aloy.

This heat recovering capacity was found to vary when the raw materials were insulated and showed a considerable conservation of energy of about 10% - 20% of the required melting energy.

throughout the country it can conserve a large amount of energy which isRecovering industrial waste heat can be achieved via numerous methods.
Combustion air preheating, Boiler feed water preheating, Load preheating, Power generation, Transfer to liquid or gaseous process streams, etc are some of the typical waste heat recovery options .
The selection of heat recovery method will depend on key factors suchas the temperature, phase, and chemical composition of the exhaust stream, as well as the nature of the desired enduse for recovered heat.

3. Problem statement

In casting industry there are more losses of heat in exhaust,these heat will be 20-25% of total heat.then we use this heat to heat the raw material or scrap.and recovered waste heat to preheating.with suitable arrangement.and improve the efficiency of plant.

4. Objective

From this paper the future energy conserving solution are obtained. These solutions are may be effective enough to reduce global energy crisis & Global warming effect.
From Foundry the energy use is in too much amount, but energy loss in the foundry is also in a high amount, hence we can re-use this wastage of energy for various purpose.
Improving reuse of wastage of energy is a Global solution to the casting industry.
Applying new technologies related to the casting process which leads to the minimum consumption of energy.

5. Methodology

Energy savings can be achieved in two ways:
Direct savings through lower fuel consumption indirect savings through lower material consumption.
Therefore, for energy savings in the foundry; less fuel and less material should be used for producing a certain quantity of products.
To accomplish this an understanding of the flows of energy and materials in the casting process is

required melting, refining, holding, fettling, machining and inspection.
The energy consume melting, refining and holding activities are the most of the energy involved in casting at least 60% thus, the direct energy savings should be achieved in this step.

5.1 Direct saving

Saving through preheating the scrap
Saving through melting
Saving through treating and refining of metal
saving through holding

5.2 Indirect saving

Savings through operational material efficiency improvement. Savings through plant management.

Saving through preheating the scrap and loading

The first step of the melting process is the preheating of the metal. There are some benifits of preheating it can reduce moisture and other organics substance, which helps preventing explosion in the furnace it can increase the melting capacity of the furnace; and it can reduce the energy required for melting.
Especially for aluminium alloy, preheating can inhibit slag formation when the hot aluminium comes into contact with moisture .

The foundry often use the hot flue gases from melting furnace to preheat the metal. calculate how much energy could be saved by preheating in the iron foundry sector. Using recovered exhaust gases should be seen as the primary method of reheating. However, loading or transferring the preheated metal may cause the loss of vast amounts of heat through convection and radiation. Therefore, reducing the energy lost during transportation can retain significant amounts of energy and reduce the energy required by melting. To get this efficiency the scrap pre-heating or melting operations should be close to each other and a lean tool such as 5S could be employed.

6. Scope

In today's world energy crisis are expanding day by day, So we have use the basic energy conserving solutions in each & everything we are using in daily life.

In our Industrial sector, we using very large amount of energy (about 45% of total energy). In casting process, energy used is in very large quantity. So we are providing future energy conserving & energy reuse solutions.

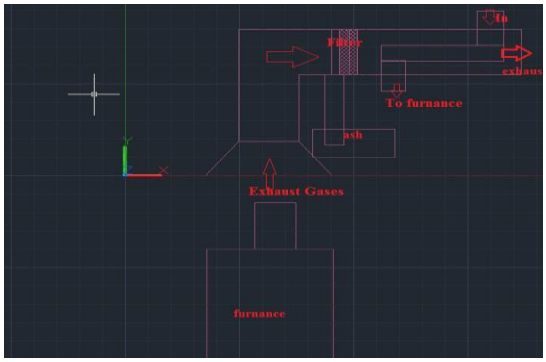
In Casting process, we just lose 25%- 35% energy in exhaust gases, so we are going to reutilize this energy . To pre-heat the scrap, Steam generation, Air pre-heating and conserve some amount of energy. Also, now we can use some renewable sources & new Technologies like Solar Furnaces. Thus the non-renewable sources consumption is reduced.
Pollution is also reduced in enviorment, hence we reduce global warming, ozone depletion.

7. Calculations

For normal process
Heat required for heating aluminium,
Energy =(mass of aluminium) x(specific heat of aluminium) x (change in temperature)
$Q = m \times cp \times \Delta t$
=(500kg/hr) x(1hr/3600) x 0.91 x (1073-298)
=(500/3600) x 0.91 x (1073-298)
q = 97.95 kj/sec
Heat required for change in phase,
(i.e. Solid aluminium to liquid aluminium)
$Q_{sl} = \dot{m} \times h$
=500kg/3600 x 398 (latent heat of aluminium=h=398 kj/sec)
Q_{sl} = 55.27 kj/sec
Total heat required for melting of aluminiun :-
$Q_{total} = q + q_{sl}$
=97.95+55.27
=153.24kj/sec
In modified system, heat gain by aluminium in duct,
$Q_{duct} = \dot{m}_{al} \times (c_p)_{al} \times (\Delta t)$
= (500kg/3600sec) x 0.91 x (533-298)
=29.70 kj/sec
Since, their is reduction in heat requirement of melting aluminium.
Modified heat requirement,
$Q_{req.} = q_{total} - q_{duct}$
= 153.25 - 29.70
=123.54 kj/s.
Fuel consumption :-
Daily fuel consumption,=l=120 ltr.
120*3=360lit/day.

$Q = m_f * c.v./24*3600$
Q_f = 174.34 kj/s.
Reduced heat requirment,
$Q_{redu} = q_{fuel} - q_{req}$
= 174.34 -123.54
= 50.8 kj/sec.
Fuel required for,q =50.8 kj/sec
M_s = 50.8 *24 * 3000 / 41840
= 104.9 lit/day.
Efficiency of consumption
= 104.9 / 360
=29.13 %
Save fuel per year =104.9 * 12 * 30
= 37764 lit./ year

8. Cad Model Of all Process -



9. Conclusion-

From the analysis and the energy recovery calculations it was found that this methodology of heat recovery provides for the considerable amount of energy conservation when practiced in industries throughout. Being simple There were also several method suggested for heat recovery, like preheating from the flue gas of the furnace]in its construction it can be easily implemented in the industries without difficulties

10. REFEREANCES

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